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WATER-QUALITY CHARACTERISTICS OF INFLOW TO AND OUTFLOW FROM B. EVERETT JORDAN LAKE, NORTH CAROLINA, 1982-86

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 90-4096

Prepared in cooperation with the

U.S. ARMY CORPS OF ENGINEERS

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By Ronald G. Garrett

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Raleigh, North Carolina

1990

U.S. DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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INTERNATIONAL SYSTEM UNITS

The following factors may be used to convert inch-pound units published herein to the International System of Units (SI).

Multiply inch-pound unit	By	To obtain SI unit
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
acre	0.4047	hectare
	Volume	
gallon (gal)	3.785	liter (L)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	28.32	liter per second (L/s)
	Mass	
pound (lb)	453.6	gram
ton (short, 2,000 pounds)	0.9072	megagram (Mg)
ton per square mile (ton/mi^2)	0.3503	megagram per square kilometer (Mg/km^2)
	Specific conductance	
micromho (umho) per centimeter at 25 degrees Celsius	1.000	microsiemen per centimeter ($\mu S/cm$) at 25 degrees Celsius

Temperature: In this report temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F = 1.8\ (°C) + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

WATER-QUALITY CHARACTERISTICS OF INFLOW TO AND OUTFLOW FROM B. EVERETT JORDAN LAKE, NORTH CAROLINA, 1982-86

By Ronald G. Garrett

ABSTRACT

B. Everett Jordan Lake, a 13,900-acre reservoir in the north-central Piedmont of North Carolina, was completed in February 1982. Hydrologic data were collected at four inflow sites and one outflow site to define water-quality characteristics. Hydrologic data collected include streamflow data and 56 physical and chemical characteristics of streamwater.

Compared to background concentrations in streams relatively unaffected by man, certain constituents at inflow sites were as much as 83-times greater. At the outflow site, however, concentrations of these constituents generally were less than 6-times greater than background values.

The minimum dissolved-oxygen concentration measured at an inflow site was 1.0 milligram per liter, whereas the minimum concentration measured at the outflow site was 4.9 milligrams per liter. Significant differences in other physical characteristics between inflow and outflow include a reduction in maximum concentration of suspended sediment from 2,360 milligrams per liter at an inflow site to 130 milligrams per liter at the outflow site and a reduction of maximum specific conductance values from more than 1,100 microsiemens per centimeter at an inflow site to 301 microsiemens per centimeter at the outflow site.

The maximum concentration of total nitrogen was 27 milligrams per liter at inflow sites and 3.2 milligrams per liter at the outflow site. The maximum total phosphorus concentration was 13 milligrams per liter at inflow sites and 0.6 milligram per liter at the outflow site.

Average annual loads of total nitrogen and total phosphorus in the outflow were as much as 67 and 40 percent of estimated inflow loads,

respectively. Although maximum inflow yields were 5.8 tons per square mile per year for nitrogen and 1.4 tons per square mile per year for phosphorus, outflow yields for the basin averaged about 1.5 and 0.2 tons per square mile per year, respectively.

INTRODUCTION

B. Everett Jordan Lake (Jordan Lake), a 13,900-acre multi-purpose reservoir for water supply, flood control, fish and wildlife conservation, and recreation, is located in the north-central Piedmont region of North Carolina. The Jordan Lake basin covers 1,689 mi^2 (square miles) and constitutes approximately 20 percent of the Cape Fear River basin (fig. 1).

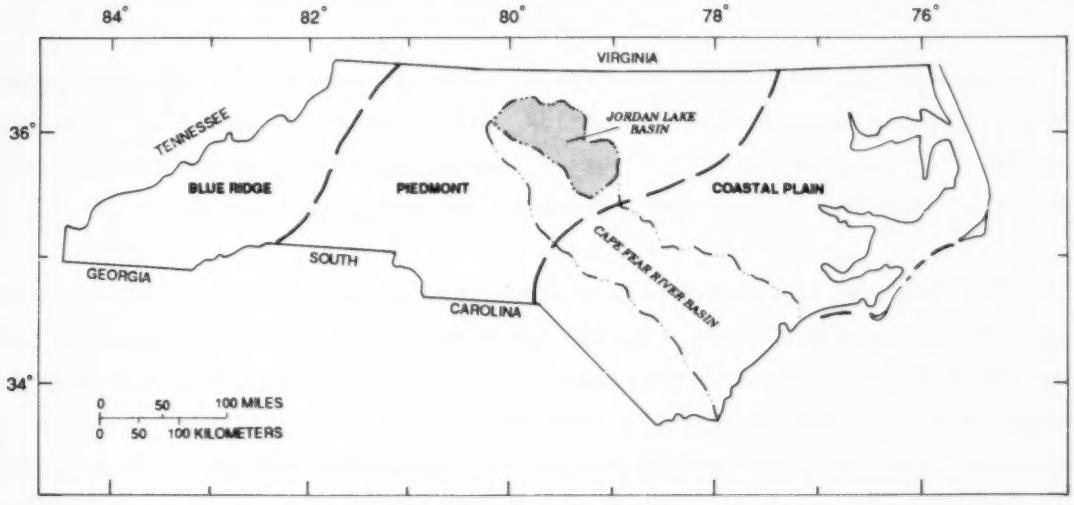

Figure 1.--Jordan Lake basin and physiographic regions of North Carolina.

Congress authorized construction of B. Everett Jordan Dam in 1963, and work began in 1970. Filling of the lake began in the fall of 1981, and normal pool elevation of 216 ft (feet) was reached in February 1982.

As a potential regional water-supply source for the cities of Chapel Hill and Durham, water-quality information for Jordan Lake is critical to effective water management, planning, and protection activities for the resource. In October 1982, the U.S. Geological Survey (USGS), in cooperation with the U.S. Army Corps of Engineers, began a study to

determine water-quality characteristics of inflow to and outflow from Jordan Lake. The collection of data was completed in November 1985. All streamflow and water-quality data collected at the study sites were published annually in U.S. Geological Survey Water-Data Reports (1983-86).

Purpose and Scope

This report describes selected water-quality characteristics of streams flowing into and out of Jordan Lake for the period 1982 through 1986. Hydrologic data collection included measurements of streamflow, physical characteristics such as dissolved-oxygen concentrations, water temperature, pH, suspended-sediment concentrations, and specific conductance, and concentrations of major dissolved constituents, nutrients, and selected minor elements.

The study was designed to allow for comparisons of the physical and chemical constituents of the inflows from major tributaries to Jordan Lake and those of the outflow, and for comparisons with background water-quality characteristics of streams in relatively undeveloped basins. Estimated annual nitrogen and phosphorus loads and yields into and out of Jordan Lake were also determined.

Basin Description

Jordan Lake basin is in one of the most industrialized and rapidly-growing areas in the State (North Carolina Department of Natural Resources and Community Development, 1985). The area includes the cities of Burlington, Chapel Hill, Greensboro, and part of Durham, including the Research Triangle Park.

Jordan Lake basin lies mostly in parts of Alamance, Caswell, Chatham, Durham, Forsyth, Guilford, Orange, Rockingham, and Wake Counties. For purposes of the study, Jordan Lake basin was divided into the Haw River subbasin and the New Hope Creek subbasin (fig. 2). The Haw River subbasin drains about 75 percent of the total basin area above the northwest arm of Jordan Lake and includes the Greensboro, Burlington, Graham, and Mebane urban areas.

The New Hope Creek subbasin includes Morgan Creek and Northeast Creek, which drain part of Durham, Chapel Hill, and the Research Triangle Park.

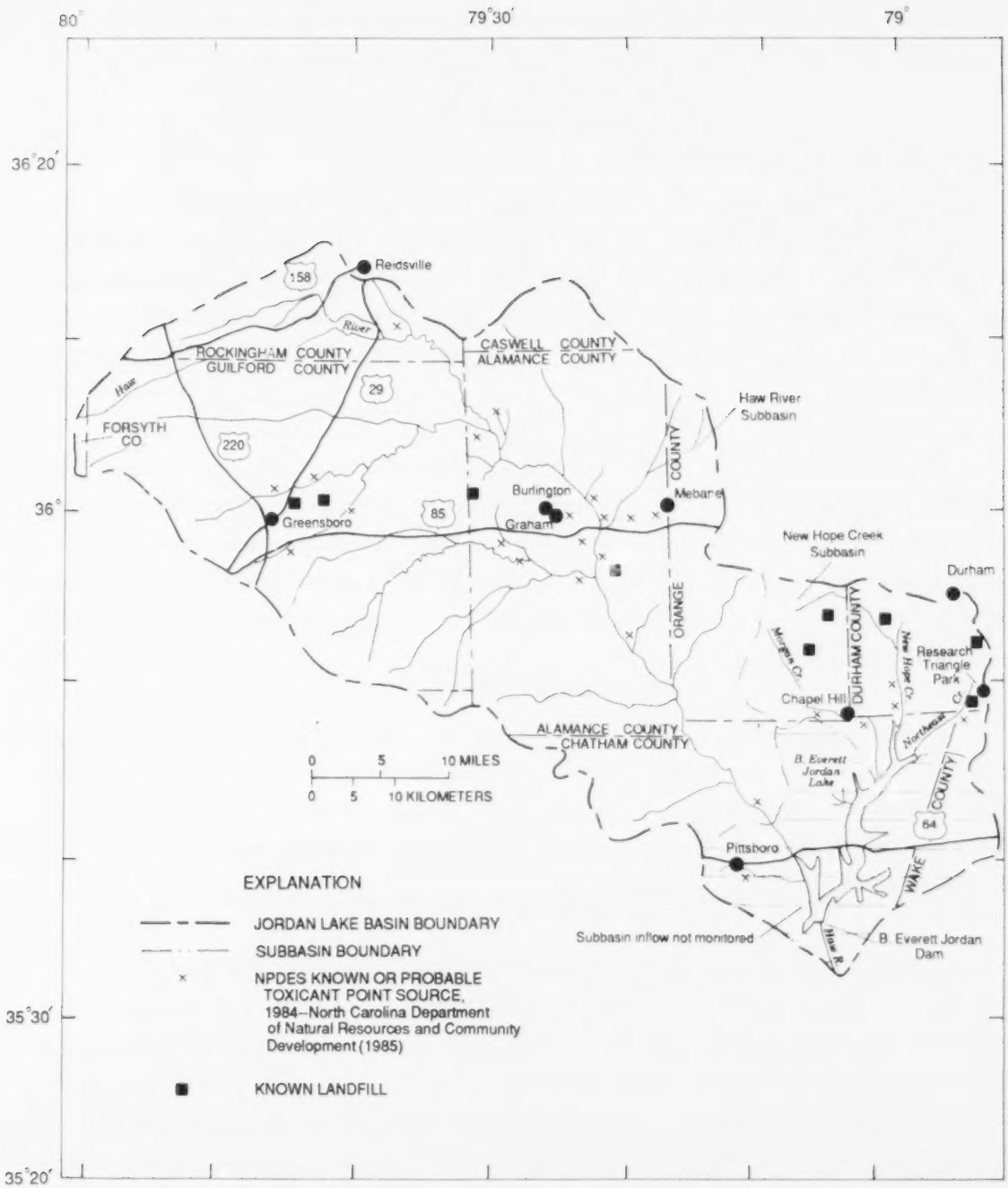

Figure 2.--Tributaries, subbasins, known or probable National Pollutant Discharge Elimination System (NPDES) toxicant point sources (1984), and known landfills in the Jordan Lake basin.

This subbasin constitutes about 8 percent of the Jordan Lake basin. The remainder of Jordan Lake basin, mostly the area immediately surrounding the lake, was not monitored during the study.

The predominate land uses in the Jordan Lake basin are forests and agriculture (North Carolina Department of Natural Resources and Community Development, 1985), with approximately 10 percent of the basin urbanized. In 1980, Greensboro, the largest city in the basin, had a population of 155,000 making it the second largest city in the State at that time (North Carolina Office of State Budget and Management, 1985). Populations of two other major cities in the basin, Burlington and Chapel Hill, were 37,300 and 32,400, respectively. The city of Durham, which lies on the boundary of the basin, had a population of 100,500.

The climate of Jordan Lake basin is characterized by hot, humid summers, mild winters, and long growing seasons. The maximum mean monthly temperature occurs in July and ranges from approximately 84 °F (Fahrenheit) to 91 °F. The minimum mean monthly temperature occurs in January and ranges from about 31 °F to 40 °F. Precipitation averages around 45 inches per year in the basin, with extremes during the period 1930 through 1986 of 57 inches in 1931 and 27 inches in 1941. Average rainfall during the study period was approximately 45 inches per year. Precipitation for the Greensboro area ranged from a total of 30 inches in 1986 to 50 inches in 1984 (National Oceanic and Atmospheric Administration, 1984 and 1986).

Lake and Dam

Jordan Lake, constructed by the U.S. Army Corps of Engineers, was formed by damming the Haw River just below the confluence with the New Hope Creek. Filling of the lake began in the fall of 1981, and normal pool elevation of 216 ft was reached in February 1982. The length of the lake at this elevation is 5 mi (miles) along the Haw River arm and 17 mi along the New Hope Creek arm. The shoreline length at normal pool elevation is about 150 mi. The reservoir capacity at normal pool elevation is 215,100 acre-ft (acre-feet). Maximum capacity at the spillway crest elevation of 240.0 ft is 753,560 acre-ft (A. Piner, U.S. Army Corps of Engineers, oral commun., 1989).

The dam is a zoned earth and rock fill structure with a side-channel, free-flowing spillway and a multiple-level intake structure. It is 1,330 ft long and 113 ft high.

Potential Sources for Contamination

As of 1984 there were 167 National Pollutant Discharge Elimination System (NPDES) permits issued for point-source discharges in the Jordan Lake basin (North Carolina Department of Natural Resources and Community Development, 1985). The Haw River subbasin contains 121 discharge sites, and 46 of these sites are located in the New Hope Creek subbasin. Of these dischargers, 25 are known or probable sources of toxicants (fig. 2), 17 of which are near Greensboro or Burlington. The major municipal point-source dischargers in the Haw River subbasin are at Greensboro, Burlington, Graham, Mebane, and Reidsville.

Three major municipal sewage-treatment plants discharge into the New Hope Creek subbasin. They are the Orange Water and Sewer Authority Plant for Chapel Hill, which discharges into Morgan Creek; the City of Durham's Farrington Road Plant, which discharges into New Hope Creek; and the Durham County Research Triangle Plant, which discharges into Northeast Creek.

Potential nonpoint sources of pollution in the basin include agricultural lands, landfills, and urban areas. Agricultural lands account for about 24 percent of the basin. Approximately 10 percent of this land is highly erodible, with erosion rates estimated to be greater than 12 tons per acre per year (U.S. Soil Conservation Service, 1984). Potential contaminants that may be derived from agricultural sources include metals and organic compounds that can be sorbed to soil particles and transported to receiving waters by erosion.

Nine known landfills are in the basin (fig. 2). The urban areas around Greensboro, Burlington-Graham, Chapel Hill, and Durham-Research Triangle Park are the major contributors to these landfills.

DATA COLLECTION AND ANALYSES

Study Sites

Hydrologic data were collected at five sites within the study area including sites 1-4 for monitoring inflow and site 5 for monitoring outflow (fig. 3). Information related to type of data collected and frequency of sampling at the study sites is presented in table 1.

Three of the inflow study sites were located downstream from the outfalls of wastewater-treatment plants, which are the most downstream sources of wastewater discharge in these tributaries to Jordan Lake. These sites include New Hope Creek near Blands (site 2, downstream from Durham's Farrington Road Treatment Plant); Northeast Creek at Secondary Road 1100 near Genlee (site 3, downstream from Durham County Research Triangle Plant); and Morgan Creek near Chapel Hill (site 4, downstream from Orange Water and Sewer Authority Plant).

The fourth inflow site, Haw River near Bynum (site 1), which is immediately upstream of Jordan Lake, was used to monitor the quality of inflow from 75 percent of the total drainage basin. This network of four sampling sites provides information for characterization of the water quality of inflow from 83 percent of the drainage basin of the lake. The effects of water-quality inflow from the remaining 17 percent of the basin were not thought to be significant because major waste dischargers were not located in the unmonitored area.

Sampling and Laboratory Procedures

Water-quality samples were collected for a wide range of flow conditions. For comparative purposes, these data were generally collected synoptically at all sites to minimize differences in quality between sites caused by variations in flow and climatic conditions. Samples were collected monthly for most constituents with additional samples collected during selected high-flow periods to better define the effects of storm runoff.

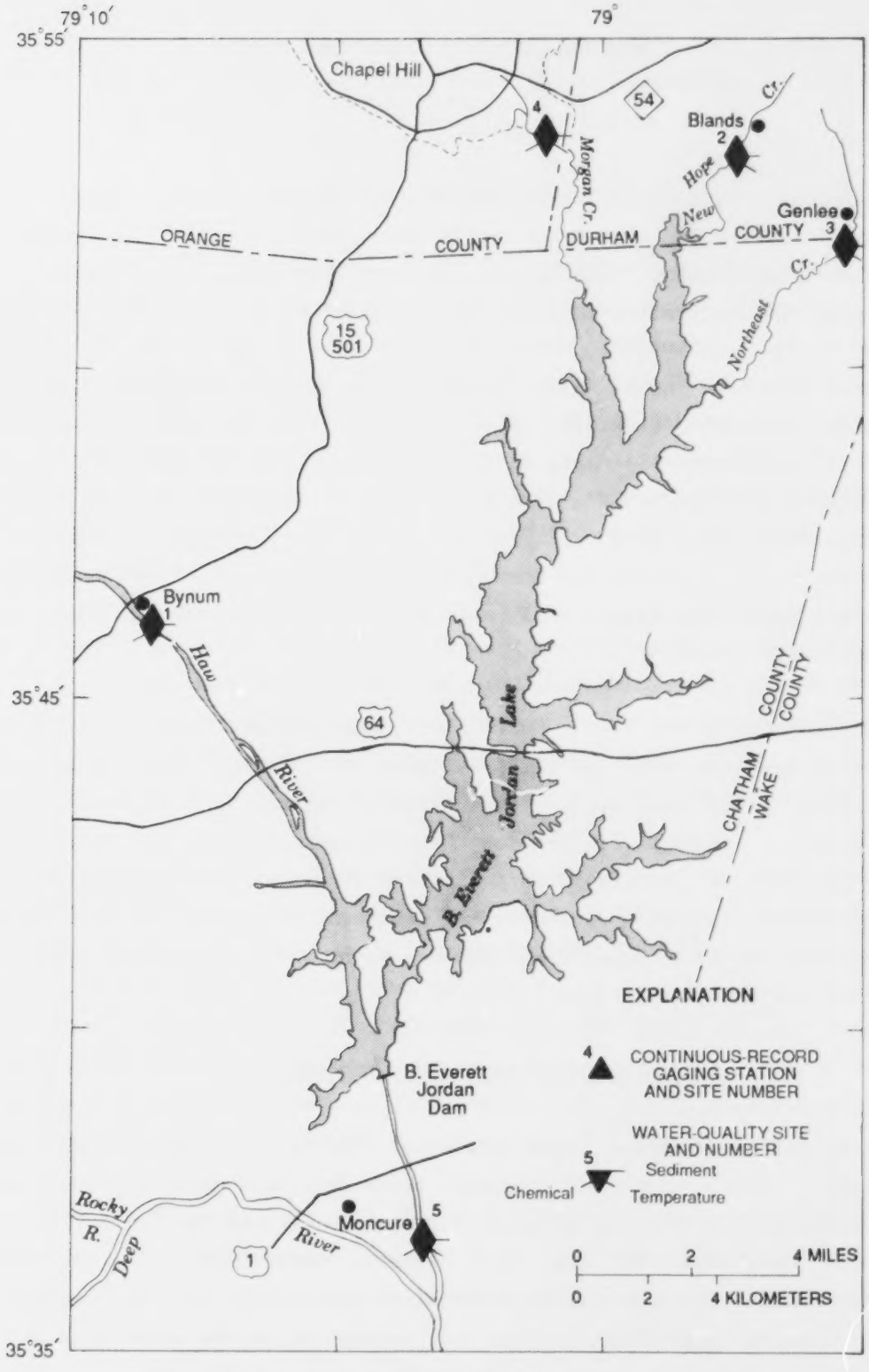

Figure 3.--Study sites in the Jordan Lake basin.

Table 1.--*Types and frequency of data collection at study sites in the Jordan Lake basin, October 1982 to November 1985*

[C, continuous; M, monthly]

Site number (figure 3)	Station name and number[1]	Drainage area (square miles)	Percent drainage area to total basin area	Sampling frequency for indicated type of data						
				Discharge	Specific conductance	Temperature	Major dissolved constituents	Nutrients	Minor elements	Suspended sediment
1	Haw River 02096960	1,275	75	C	C	C	M	M	M	M
2	New Hope Creek 02097314	75.9	5	C	C	C	M	M	M	M
3	Northeast Creek 0209741955	21.1	1	C	C	C	M	M	M	M
4	Morgan Creek 02097517	41	2	C	C	C	M	M	M	M
5	Haw River below Jordan Lake Dam 02098198	1,689	100	C	C	C	M	M	M	M

[1]U.S. Geological Survey downstream order identification number.

To ensure the collection of representative samples and consistency in sampling techniques, all samples were collected using depth-integrating methods as discussed by Guy and Norman (1970). Depending upon flow conditions, the following samplers were used: DH-48TM, DH-76TM, or the D-74TM. Samples analyzed for dissolved constituents were filtered through a 0.45 micron membrane filter immediately after collection. Sample preservation, if required, was done after filtration. Samples collected for nutrients were preserved with mercuric chloride and chilled to 4 °C (Celsius). Samples for the analysis of selected major constituents and minor elements were preserved immediately after collection by the addition of nitric acid to a pH of less than 2. Physical and chemical characteristics, such as pH, alkalinity, dissolved oxygen, and specific conductance, were analyzed in the field at the time of sample collection.

Chemical analyses were performed in the U.S. Geological Survey National Water-Quality Laboratories. The methods and procedures used by the Survey laboratories are documented in the report, "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments" (Fishman and Friedman, 1985). Concentrations of suspended sediment were determined in the U.S. Geological Survey District sediment laboratory in Raleigh, North Carolina.

Nutrient Load Estimation Technique

During the second year of the study, the U.S. Army Corps of Engineers requested the computation of annual loadings of nitrogen and phosphorus for inflow to and outflow from Jordan Lake. No attempt was made to define seasonal variations or seasonal loads because of the inherent inaccuracies caused by minimal sampling frequency. The method chosen to calculate loads uses logarithmic regression equations to relate the independent variable (instantaneous water discharge) to the dependent variable (nutrient load) at the time each sample is collected (R.M. Hirsch, U.S. Geological Survey, oral commun., 1983). The regression equation developed was:

$$\log (\text{load}) = b \log (\text{discharge}) + \log a \qquad (1)$$

When transformed back to the original form of the data, the equation is:

$$\text{load} = a\ (\text{discharge})^{b} \qquad (2)$$

where: a is the regression constant and
b is the regression coefficient.

Because a continuous record of stream discharge was available for each study site, resultant equations can be applied to values of daily discharge data to estimate corresponding daily nutrient loads. Daily nutrient loads were then summed for the water year to estimate annual nutrient loads.

The equations developed for the nutrient-water discharge relation as well as the coefficient of determination (r^2) are listed in table 2. The r^2 value is a statistic that indicates the extent to which the changes in the independent variable (instantaneous water discharge) account for changes in the dependent variable (nutrient load). Generally, the closer the r^2 value is to 1.0, the better the relation between discharge and nutrient

Table 2.--*Regression equations for daily nitrogen and phosphorus loads at the study sites, 1983-85*

[r^2, coefficient of determination; Q, daily mean discharge in cubic feet per second]

Site number (figure 3)	Station name and number[a]	Regression analysis for nitrogen (N) load, in tons per day			Regression analysis for phosphorus (P) load, in tons per day		
		Number of samples	Regression equation	r^2	Number of samples	Regression equation	r^2
1	Haw River 02096960	40	$N=0.0080Q^{0.96}$	0.95	40	$P=0.0030Q^{0.85}$	0.90
2	New Hope Creek 02097314	42	$N=.0608Q^{.60}$	.81	43	$P=.0186Q^{.48}$	.62
3	Northeast Creek 0209741955	42	$N=.0561Q^{.54}$	.76	42	$P=.0188Q^{.41}$	.48
4	Morgan Creek 02097517	40	$N=.1368Q^{.45}$	.67	40	$P=.0728Q^{.24}$	.42
5	Haw River below Jordan Lake Dam 02098198	38	$N=.0039Q^{1.01}$	.96	36	$P=.0008Q^{.92}$	.90

[a]U.S. Geological Survey downstream order identification number.

load. The statistical and related values presented were computed using various Statistical Analysis System[1] programs (SAS Institute, Inc., 1982 and 1985).

STREAMFLOW CONDITIONS

Streamflow has been continuously monitored at Haw River near Bynum (site 1) since October 1973 and at Haw River near Moncure (site 5) since October 1965. Continuous streamflow-data collection at the other three sites was begun in October or November 1982. Discharge data from these sites for water years[2] 1983-86, the period of water-quality data collection and analysis, are presented in table 3.

Table 3.--*Mean, maximum, and minimum daily discharges at the study sites, water years 1983-86*

Site number (figure 3)	Station name and number[a]		Discharge (cubic feet per second) 1983	1984	1985	1986
1	Haw River	Mean	1,440	2,110	962	743
	02096960	Maximum	18,800	22,500	19,000	24,900
		Minimum	.18	23	81	37
2	New Hope Creek	Mean	118	157	69	77
	02097314	Maximum	1,830	2,240	1,580	3,150
		Minimum	11	8.7	6.5	11
3	Northeast Creek	Mean	30	45	16	24
	0209741955	Maximum	704	1,000	2,587	911
		Minimum	1.5	1.9	2.2	1.2
4	Morgan Creek	Mean	[b]61	76	33	32
	02097517	Maximum	788	1,130	742	1,270
		Minimum	24	9.3	11	6.5
5	Haw River below Jordan Lake Dam	Mean	2,010	2,800	1,160	1,110
		Maximum	12,700	14,000	14,000	15,300
	02098198	Minimum	199	168	207	209

[a]U.S. Geological Survey downstream order identification number.
[b]Based on 11 months' record from November 1982 through September 1983.

[1]Use of firm or trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.
[2]Period extending from October 1 through the following September 30. See Glossary.

During two of these years, streamflow conditions were extreme; 1984 was unusually wet and 1985 was unusually dry. The effects of wet and dry conditions on streamflow are shown in figure 4, which gives a graphic comparison of monthly mean discharges at Haw River near Bynum (site 1) for water years 1984 and 1985 and for the period 1974 through 1986. The mean discharge of 2,110 ft^3/s (cubic feet per second) for the 1984 water year was approximately 60 percent higher than the 13-year mean of 1,330 ft^3/s; for the 1985 water year, the mean discharge of 962 ft^3/s was approximately 30 percent lower than the 13-year mean.

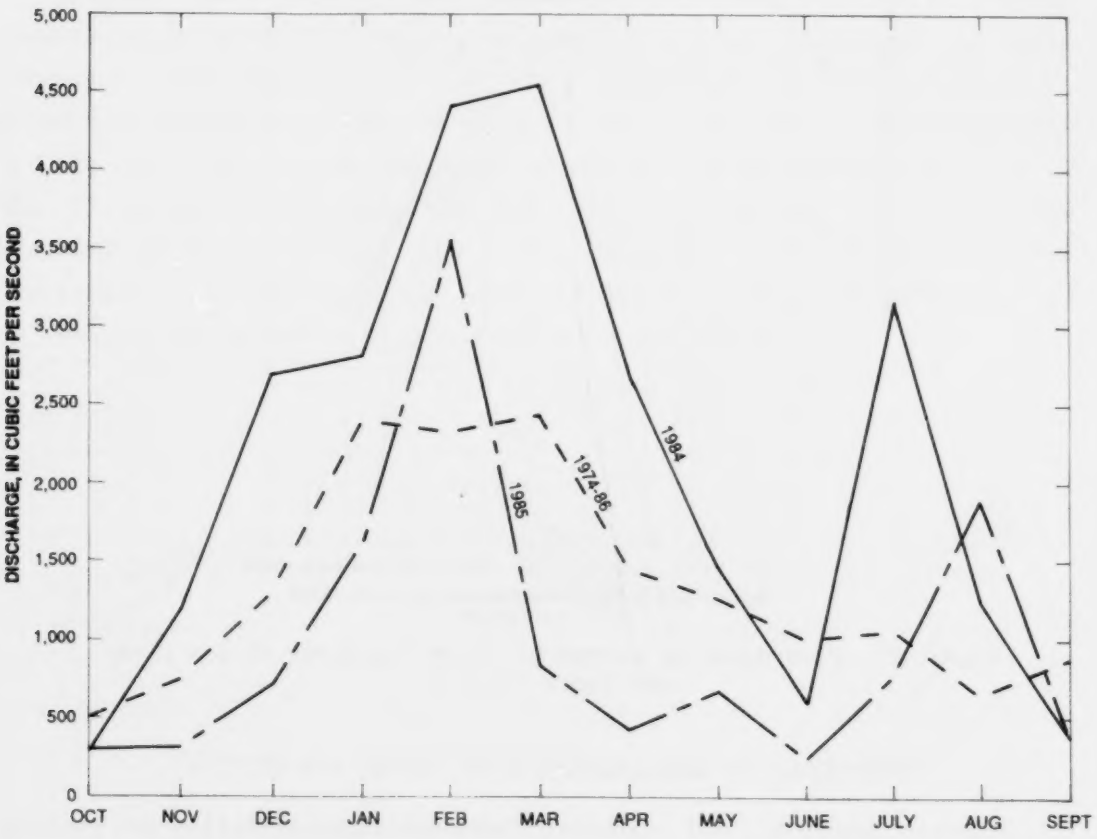

Figure 4.--Monthly mean discharge at Haw River near Bynum (site 1) for water years 1984 and 1985 and mean monthly discharge for water years 1974-86.

Flow-duration curves for Haw River near Bynum (site 1) are shown in figure 5 for water years 1974 through 1986 and for 1984 and 1985. This provides a comparison of the percentages of time that discharge equaled or

exceeded certain flow rates during the two extreme years and for the long-term period. In general, low flows less than about 200 ft^3/s did not occur as frequently during 1984 and 1985 as during the period 1974 through 1986.

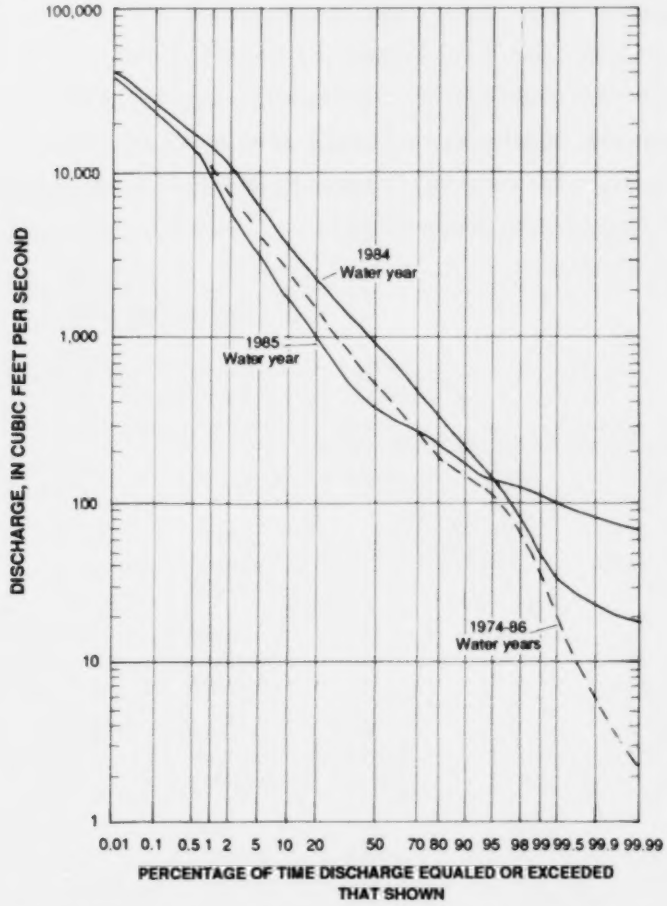

Figure 5.--Flow-duration curves of daily discharge at Haw River near Bynum (site 1).

WATER-QUALITY CHARACTERISTICS OF INFLOW AND OUTFLOW

Selected physical and chemical characteristics at inflow and outflow sites in the Jordan Lake basin are summarized in this section. Discussions of background water quality of the basin and of nutrient loads are also included. Where pertinent, brief comparisons between inflow and outflow data are made.

Descriptive statistics for streamflow and for 56 physical and chemical characteristics for each of the sites are presented in table 8 beginning on

page 31. The table is divided into three parts: physical properties and major dissolved constituents, major nutrients, and minor elements. The values shown include the number of samples collected and the mean, range, and standard deviation of the properties and constituents. For an indepth discussion of the importance of each of these physical and chemical characteristics, the reader is referred to Hem (1985).

Background Water Quality

Simmons and Heath (1979) describe the background water-quality characteristics of North Carolina streams relatively unaffected by man, generally those streams with 90- to 100-percent forested basins. They define five geochemical zones on the basis of similar water characteristics in North Carolina. Jordan Lake basin lies mostly within geochemical zone II (fig. 6), which coincides with the Carolina Slate Belt and the Durham and Wadesboro Triassic basins; major rock types are slates and schists. For this reason, only the background water-quality data for geochemical zone II are used for comparison with data from the study sites.

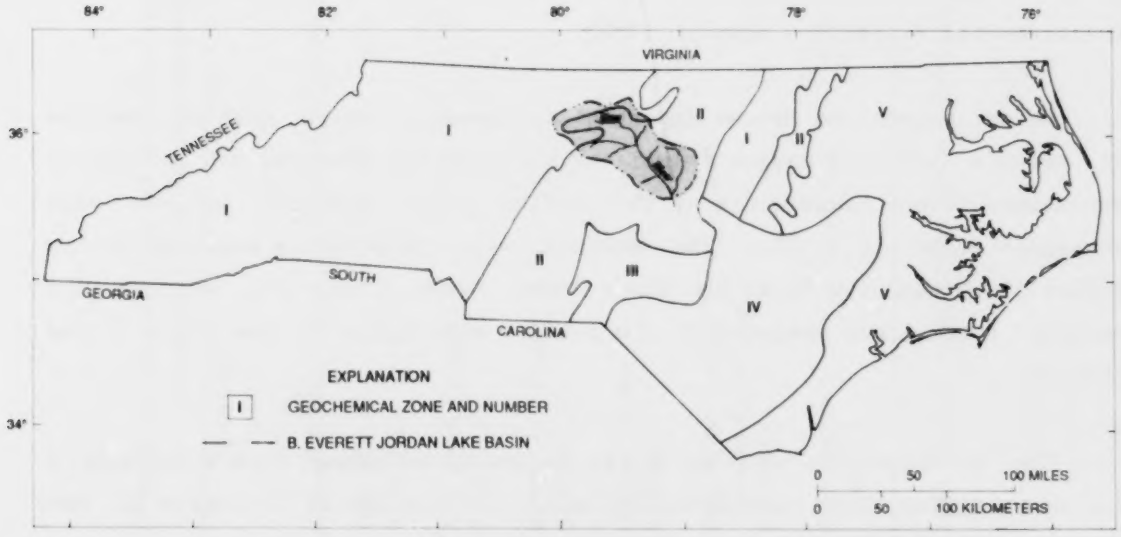

Figure 6.--The Jordan Lake basin and geochemical zones of North Carolina (Simmons and Heath, 1979).

Mean concentrations of selected constituents at the study sites and mean background concentrations of the same constituents in geochemical zone II can be compared in table 4. At the inflow sites, mean concentrations of major constituents or nutrients were from 2- to 83-times greater than concentrations reported for streams in geochemical zone II that are relatively unaffected by man. However, the mean concentrations at the outflow site were about 1.5- to 6-times greater than background concentrations in zone II.

Physical Characteristics

The following physical characteristics were measured: dissolved-oxygen concentrations, water temperature, pH, suspended-sediment concentrations, and specific conductance. Concentrations of dissolved oxygen (DO) in samples collected at the inflow sites ranged from a maximum of 14.4 mg/L (milligrams per liter) at Haw River near Bynum (site 1) to a minimum of 1.0 mg/L at New Hope Creek (site 2). The maximum DO concentration observed at the outflow site downstream from the dam (site 5) was 14.9 mg/L, and the minimum concentration was 4.9 mg/L (fig. 7). A minimum concentration of about 3 mg/L is needed to support a varied fish population (U.S. Environmental Protection Agency, 1986).

Water temperature has an important influence on water quality because it affects not only oxygen solubility but also the chemical and biological processes. Water temperature at the inflow sites and the outflow site averaged about 16.5 °C. The maximum water temperature measured at the inflow sites was 31.0 °C at Haw River near Bynum (site 1), whereas the maximum temperature measured at the outflow site below the dam (site 5) was 26.5 °C.

The pH values for samples at the inflow sites ranged from a maximum of 7.7 units at Haw River near Bynum (site 1) to a minimum of 5.4 units at New Hope Creek (site 2). At the outflow site (site 5), the maximum pH value was 8.5 units, and the minimum value was 5.4 units.

Table 4.--*Mean concentrations of selected constituents at the study sites, 1982-85, and mean background concentrations in geochemical zone II, 1973-78 (Simmons and Heath, 1979)*

Site number (figure 3)	Station name and number[1]	Constituent concentrations (milligrams per liter)							
		Calcium	Magnesium	Sodium	Potassium	Sulfate	Chloride	Nitrogen, total	Phosphorus, total
1	Haw River 02096960	7.2	3.1	22	3.8	24	14	2.5	0.48
2	New Hope Creek 02097314	9.3	3.1	22	4.3	24	18	5.7	1.4
3	Northeast Creek 0209741955	18	4	34	5.1	43	30	8.2	2.5
4	Morgan Creek 02097517	9	2.9	33	5.2	25	19	8	2.2
5	Haw River below Jordan Lake Dam 02098198	6.7	2.7	13	2.8	16	9.6	1.6	.20
--	Geochemical zone II	4.1	1.7	3.9	1	4.7	3.8	.5	.03

[1]U.S. Geological Survey downstream order identification number.

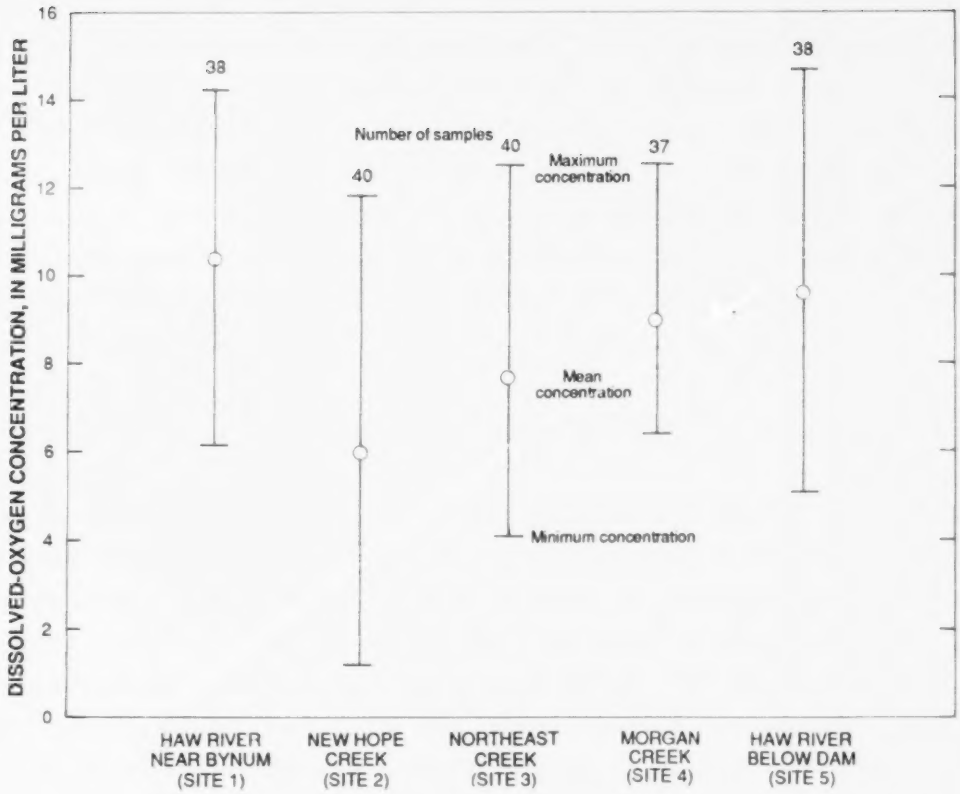

Figure 7.--Dissolved-oxygen concentrations in water at the study sites, 1982-85.

Suspended-sediment concentrations in streams are affected by numerous factors, including basin soil characteristics, topography, stream discharge, land use, and rainfall intensity. Because samples were collected at varying flow conditions, a wide range of suspended-sediment concentrations was observed at each inflow site. The maximum concentration of suspended sediment observed at the inflow sites was 2,360 mg/L at Morgan Creek (site 4), which occurred during runoff conditions. The maximum concentration observed at the Haw River outflow site (site 5) was 130 mg/L. This was considerably less than maximum concentrations observed at most of the inflow sites and is an indication of the sediment trapping ability of the Jordan Lake reservoir.

Specific conductance is a measure of the ionic strength of water and is an indicator of the amount of mineral matter dissolved in water; thus, higher concentrations of dissolved constituents produce greater values of

specific conductance. Because concentrations of most major dissolved constituents vary inversely with stream discharge, maximum specific conductance values occur during low flows, whereas minimum values occur at high flows. The maximum specific conductance observed at an inflow site was greater than or equal to 1,100 µS/cm (microsiemens per centimeter at 25 °C) at Morgan Creek (site 4). The maximum observed value at the outflow site, Haw River below the dam (site 5), was 301 µS/cm (table 5).

During low and medium flow conditions, the specific conductance, pH, dissolved oxygen, and water temperature at the inflow sites were in most cases affected by the amount of treated sewage effluent being released at the time the sample was collected. During flood conditions, however, sewage effluent had little effect on these characteristics.

Table 5.--*Maximum, minimum, and mean specific conductance from monitors at the study sites, water years 1983-85*

[Specific conductance based on hourly measurements from monitor; µS/cm at 25 °C, microsiemens per centimeter at 25 degrees Celsius; Max, maximum; Min, minimum; --, not determined; ≥, greater than or equal to]

Site number (figure 3)	Station name and number[1]	Specific conductance (µS/cm at 25 °C)									
		1983			1984			1985			1983-85
		Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Mean
1	Haw River 02096960	514	46	186	460	59	152	--	--	--	[2]169
2	New Hope Creek 02097314	492	46	207	535	38	227	532	65	280	238
3	Northeast Creek 0209741955	864	52	335	857	29	312	872	57	481	376
4	Morgan Creek 02097517	[3]≥1,100	51	≥255	[3]≥1,100	39	≥208	880	48	324	≥262
5	Haw River below Jordan Lake Dam 02098198	255	54	133	301	54	116	--	--	--	[2]125

[1]U.S. Geological Survey downstream order identification number.
[2]Specific conductance monitor discontinued September 1984. Mean value is for water years 1983 and 1984.
[3]Value exceeded the limits of monitor.

Chemical Characteristics

The chemical characteristics described in this report are presented in three main categories: major dissolved constituents, major nutrients, and minor elements. Flow conditions often influence chemical quality in a

stream, and maximum and minimum values of various constituents generally occur during extreme hydrologic events. In most cases, concentrations of major dissolved constituents, major nutrients, and minor elements were generally lower during periods of high flow when overland runoff causes a dilution effect.

With respect to major dissolved constituents, the chemical composition of the water is similar to all study sites. The proportions of major ions at the sites are shown in figure 8. Sodium and calcium are the predominant cations, with bicarbonate being the major anion at each site.

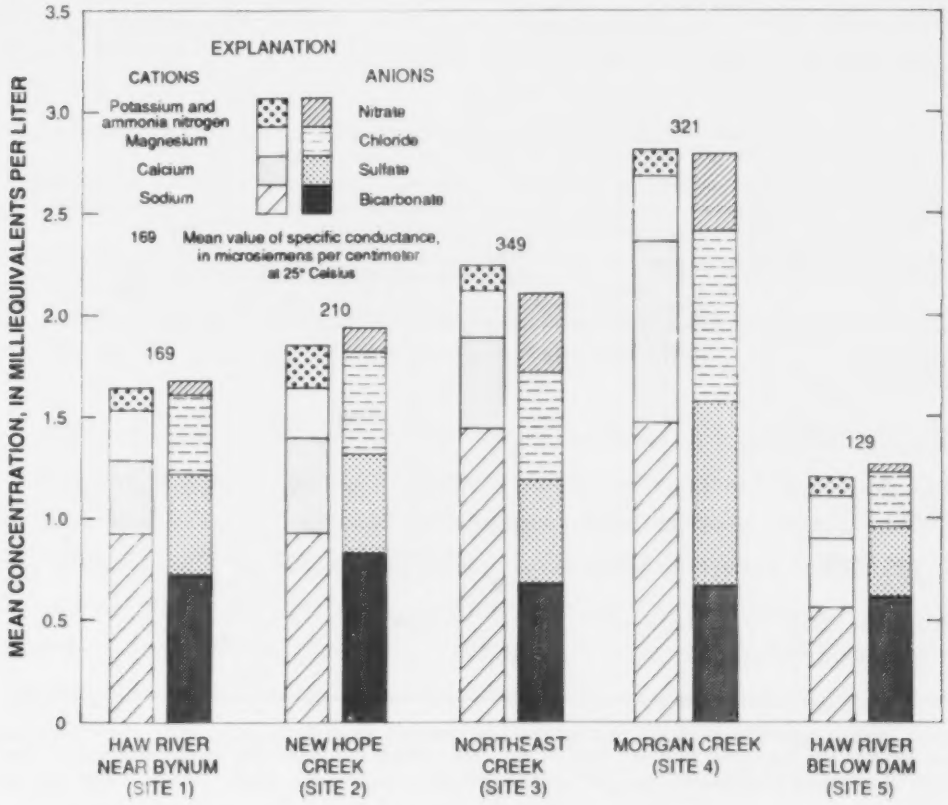

Figure 8.--Mean chemical composition of water at the study sites, 1982-85.

The nutrients nitrogen and phosphorus are required by aquatic plants for growth. They are available from many sources throughout the study area. Mean total nitrogen concentration in samples collected at each of the study

sites ranged from 8.2 mg/L in Northeast Creek (site 3) to 1.6 mg/L at site 5, the outflow site (fig. 9). The maximum concentration of total nitrogen at an inflow site was 27 mg/L in New Hope and Northeast Creeks (sites 2 and 3, respectively), whereas the maximum concentration at the outflow site (site 5) was 3.2 mg/L. The maximum concentrations of total phosphorus at the inflow and outflow sites were 13 (Northeast Creek, site 2) and 0.6 mg/L, respectively (table 8).

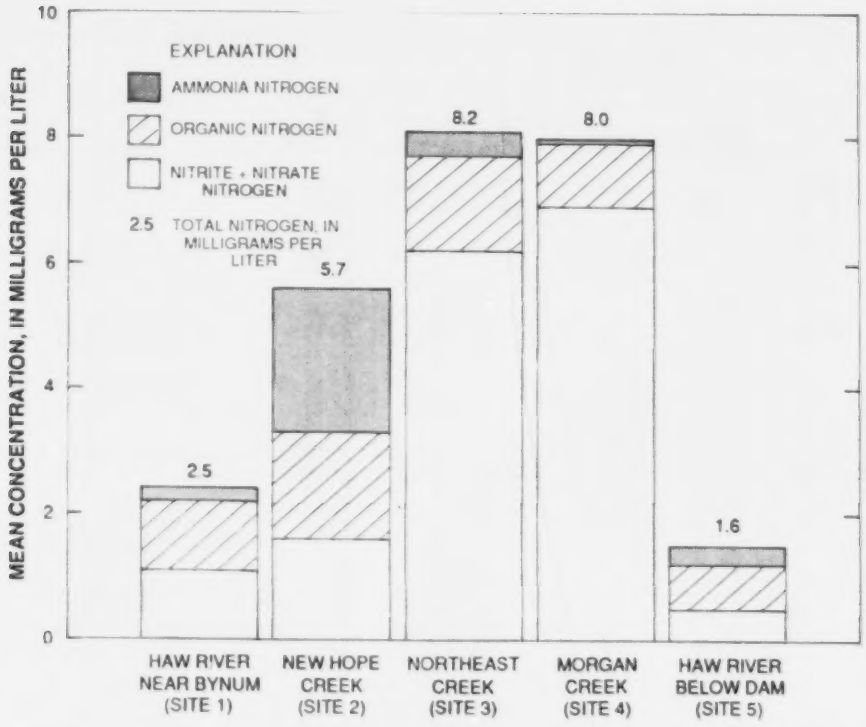

Figure 9.--Mean composition of nitrogen species in water at the study sites, 1982-85.

The two minor elements that were detected most frequently in the waters at the study sites were iron and manganese. Maximum concentrations of iron and manganese occurred during periods of overland runoff. Because maximum concentrations of these elements occurred during these periods and because most of the iron and manganese concentrations were from suspended sediment, it is apparent that soils are the primary sources of these constituents.

The maximum iron concentration at inflow sites during severe flooding was 24,000 µg/L (micrograms per liter) at Morgan Creek (site 4) (fig. 10); the maximum concentration at the outflow site, Haw River below the dam (site 5), was 4,100 µg/L. The maximum manganese concentration at the inflow sites was 1,100 µg/L during flooding at New Hope Creek, Northeast Creek, and Morgan Creek (sites 2, 3, and 4, respectively). The maximum manganese concentration at site 5, the outflow site, was 1,900 µg/L.

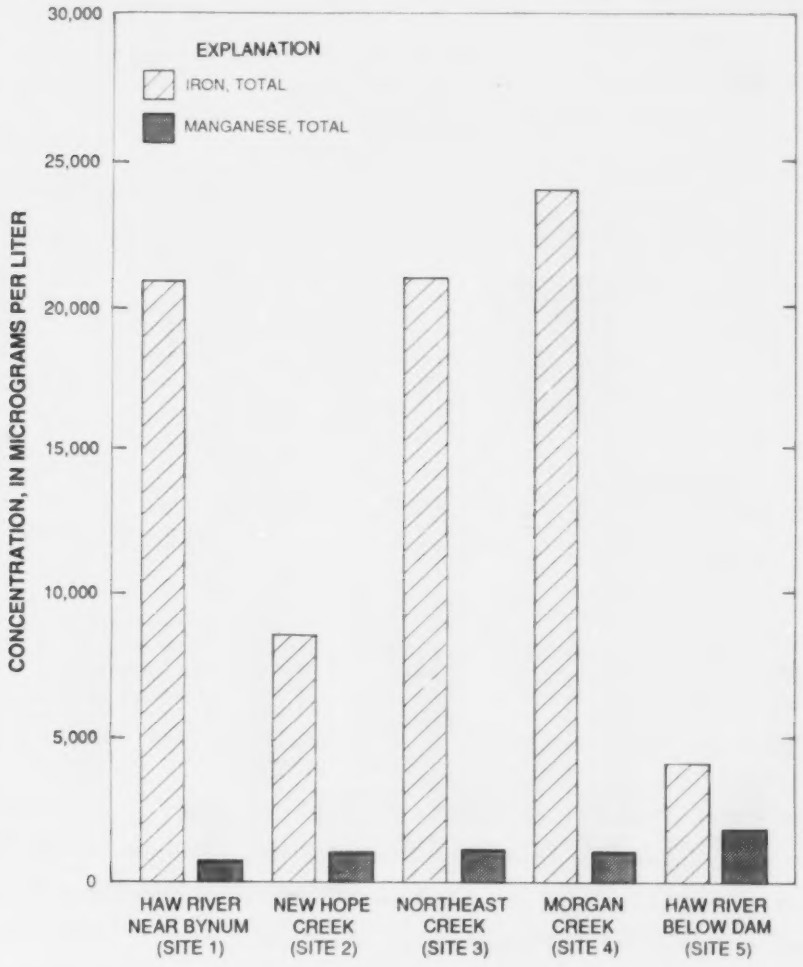

Figure 10.--Maximum iron and manganese concentrations in water at the study sites, 1982-85.

Annual Nutrient Loads

Estimates of annual nutrient loads (nitrogen and phosphorus) into and out of Jordan Lake were determined for water years 1983-86 (table 6). For the 17 percent (287 mi^2) of the watershed not monitored for inflow (fig. 2), it was assumed that load characteristics were similar to the gaged area of the study basin. Loadings from the ungaged area of the basin were then calculated as 17/83 times total loading from the gaged area.

Table 6.--*Estimated annual nitrogen and phosphorus loads at the study sites, water years 1983-86*

Site number (figure 3)	Station name and number[1]	Nitrogen load, tons per year (Percent of total inflow load)				Phosphorus load, tons per year (Percent of total inflow load)			
		1983	1984	1985	1986	1983	1984	1985	1986
1	Haw River 02096960	3,100 (69)	4,400 (70)	2,100 (67)	1,600 (63)	490 (66)	680 (68)	340 (63)	270 (58)
2	New Hope Creek 02097314	300 (7)	370 (6)	220 (7)	230 (9)	51 (7)	60 (6)	39 (7)	42 (9)
3	Northeast Creek 0209741955	89 (2)	120 (2)	70 (2)	79 (3)	20 (3)	24 (2)	17 (3)	18 (4)
4	Morgan Creek 02097517	240 (5)	300 (5)	210 (7)	200 (8)	56 (7)	66 (7)	55 (10)	54 (12)
--	Ungaged area of basin	760 (17)	1,060 (17)	530 (17)	430 (17)	130 (17)	170 (17)	92 (17)	79 (17)
5	Haw River below Jordan Lake Dam 02098198	2,900	4,200	1,700	1,700	290	400	180	170

[1]U.S. Geological Survey downstream order identification number.

Even though the total nitrogen and phosphorus loads varied greatly among sites, the percentage of the total annual contribution for each site was similar. Figures 11 and 12 give graphic comparisons of the total annual nitrogen and phosphorus loads for water years 1984 and 1985, unusually wet and dry years, respectively.

Estimates of nitrogen and phosphorus loads were also determined for the outflow site on Haw River downstream from the dam (site 5). The annual outflow nitrogen load ranged from 67 percent of inflow loads in water year 1984 to 54 percent in water year 1985. Annual outflow loads of phosphorus

ranged from 40 percent of inflow loads in water year 1984 to 33 percent in water year 1985. These percentages are an indication of the nutrient retention ability of Jordan Lake reservoir.

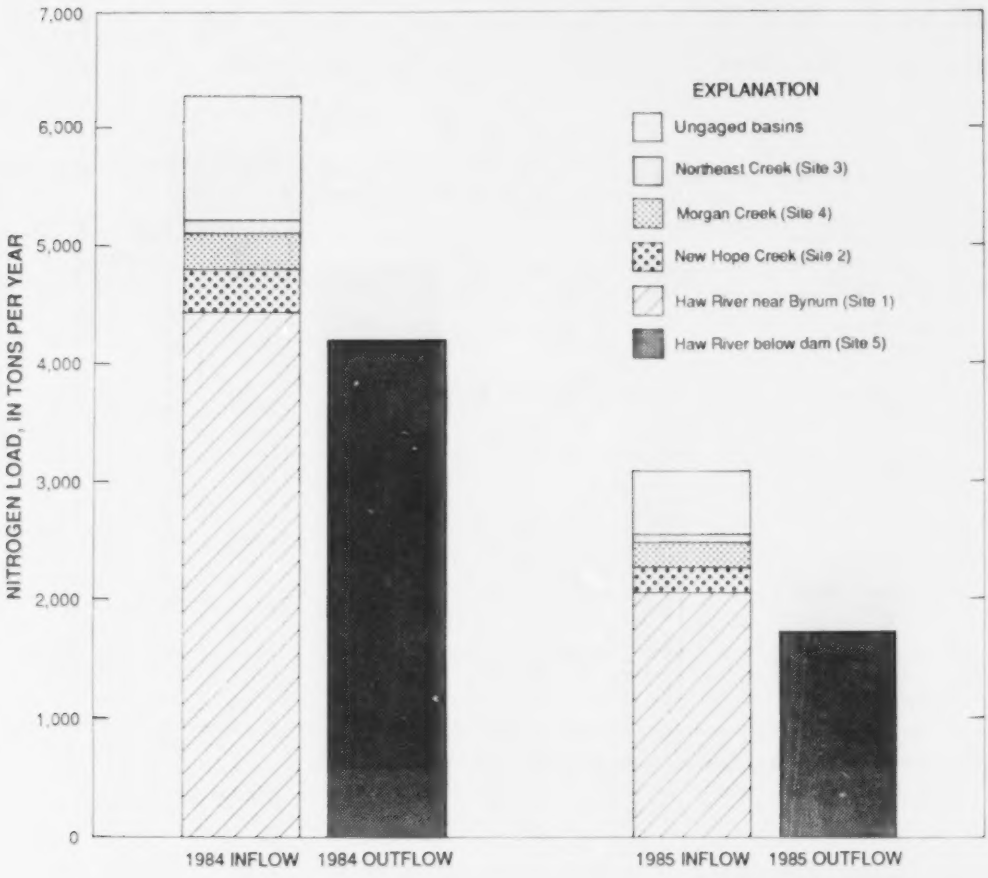

Figure 11.--Comparison of estimated inflow and outflow nitrogen loads for Jordan Lake, water years 1984 and 1985.

Estimated average annual nitrogen and phosphorus yields are presented in table 7. The yields are expressed as load per unit area of a drainage basin. Among the inflow sites, Morgan Creek (site 4) was observed to have the greatest nitrogen and phosphorus yields, 5.8 and 1.4 ton/mi^2 (tons per square mile), respectively. The smallest yields for nitrogen and phosphorus

at the inflow sites were at the Haw River near Bynum (site 1), where the yields were 2.2 and 0.4 ton/mi^2, respectively. In comparison, the outflow site, Haw River downstream from the dam (site 5), had nitrogen and phosphorus yields of 1.5 and 0.2 ton/mi^2, which were the smallest of all the study sites.

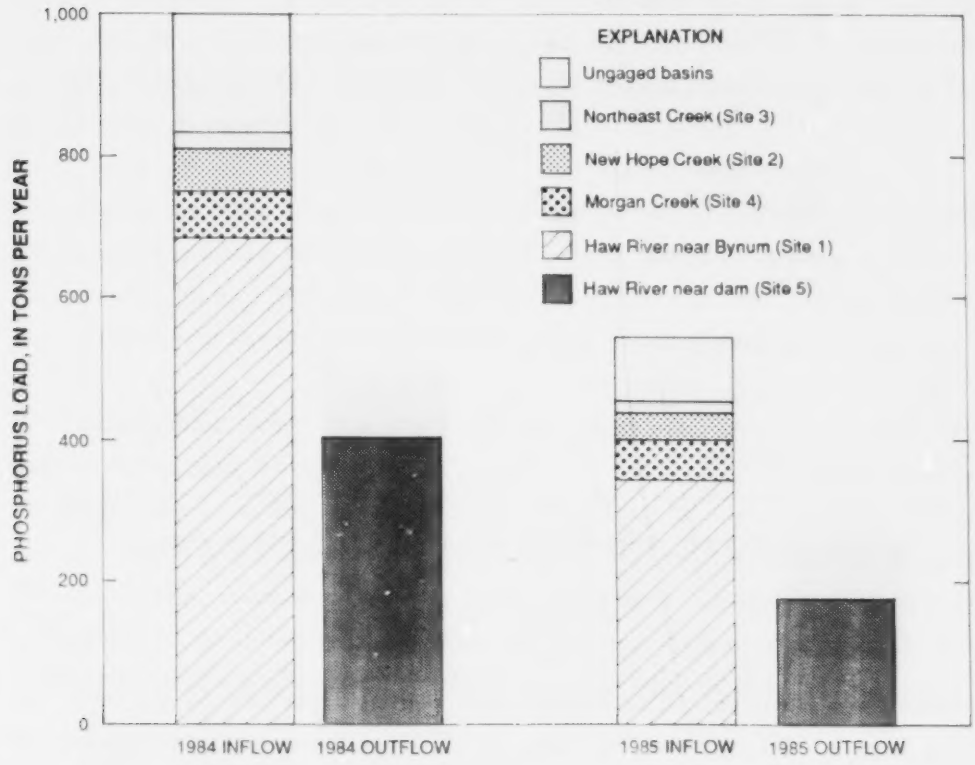

Figure 12.--Estimated inflow and outflow phosphorus loads for Jordan Lake, water years 1984 and 1985.

Table 7.--*Estimated mean annual nutrient yields in the study basin, water years 1983-86*

Site number (figure 3)	Station name and number[1]	Average annual yield (tons per square mile)	
		Nitrogen	Phosphorus
1	Haw River 02096960	2.2	0.4
2	New Hope Creek 02097314	3.7	.6
3	Northeast Creek 0209741955	4.3	1
4	Morgan Creek 02097517	5.8	1.4
--	Ungaged area of basin	2.4	.4
5	Haw River below Jordan Lake Dam 02098198	1.5	.2

[1]U.S. Geological Survey downstream order identification number.

SUMMARY

This study was undertaken to define the chemical quality of inflows to and outflow from B. Everett Jordan Lake, a 13,900-acre reservoir located in the north-central Piedmont of North Carolina. The capacity of Jordan Lake is 215,100 acre-feet at normal pool elevation of 216 feet. Jordan Lake basin drains 1,689 mi^2, of which 1,413 mi^2 was monitored for inflow water quality.

Jordan Lake basin contains 167 known point-source dischargers that include 25 known or probable sources of toxicants. Potential nonpoint sources of contamination include farmland, urban areas, and nine municipal landfills.

For this investigation, hydrologic data were collected at four sites on major tributaries to the reservoir and one outflow site. The inflow sites were located on the Haw River (site 1), New Hope Creek (site 2), Northeast Creek (site 3), and Morgan Creek (site 4). The outflow site was located on Haw River immediately downstream from Jordan Lake Dam (site 5).

Streamflow in the study basin during water years 1984 and 1985 reflected unusually wet and dry climatic conditions, respectively. Based on long-term records at the Haw River station near Bynum (site 1), streamflow into Jordan Lake was approximately 60 percent greater in 1984 and about 30 percent lower in 1985 than the long-term mean. For the period 1974 through 1986, mean discharge in the Haw River was 1,330 ft^3/s.

Water samples were collected at approximately monthly intervals at each site, but emphasis was placed on collecting samples during a wide variety of flow conditions. Streamflow was continuously recorded at each site. Water samples were analyzed for 56 physical and chemical characteristics.

Background water-quality data for streams in relatively undeveloped basins were used as a basis of comparison with which to estimate the effects of development on the water quality of inflow to and outflow from Jordan Lake. Generally, mean concentrations of major constituents or nutrients at inflow sites ranged from 2- to 83-times greater than background concentrations. However, at the outflow site mean concentrations generally were about 1.5- to 6-times greater than background concentrations.

The physical characteristics measured were dissolved-oxygen concentrations, temperature, pH, suspended-sediment concentrations, and specific conductance. Concentrations of dissolved oxygen measured at the inflow sites ranged from a maximum of 14.4 mg/L at Haw River near Bynum (site 1) to a minimum of 1.0 mg/L at New Hope Creek (site 2). The maximum dissolved-oxygen concentration observed at the outflow site (site 5) was 14.9 mg/L; the minimum concentration was 4.9 mg/L.

Water temperature at the inflow sites and the outflow site averaged about 16.5 °C. The maximum water temperature measured at the inflow sites was 31.0 °C at Haw River near Bynum (site 1), whereas the maximum temperature measured at the outflow site (site 5) was 26.5 °C.

The pH values for samples collected at the inflow sites ranged from a maximum of 7.7 at Haw River near Bynum (site 1) to a minimum of 5.4 at New Hope Creek (site 2). The maximum and minimum pH values at the outflow site (site 5) were 8.5 and 5.4, respectively.

A comparison of suspended-sediment concentrations in inflow to Jordan Lake with concentrations in the outflow gives an indication of the sediment trapping ability of the reservoir. The maximum suspended-sediment concentration observed at an inflow site was 2,360 mg/L at Morgan Creek (site 4). The maximum suspended-sediment concentration observed at the outflow site (site 5) was 130 mg/L.

Specific conductance values generally were highest during periods of low streamflow. The maximum observed specific conductance value was greater than or equal to 1,100 µS/cm and occurred at the Morgan Creek inflow site near Chapel Hill (site 4). The maximum observed value at the outflow site (site 5) was 301 µS/cm.

The chemical composition of the water at all study sites was similar with respect to major dissolved constituents. Sodium and calcium were the predominant cations, and bicarbonate was the predominant anion.

Nitrogen and phosphorus were the major nutrients of interest during the study. The maximum total nitrogen concentration at the inflow sites was 27 mg/L at New Hope Creek (site 2), whereas the maximum concentration at the Haw River outflow site (site 5) was 3.2 mg/L. The maximum total phosphorus concentration at the inflow sites was 13 mg/L at Northeast Creek (site 3), whereas the maximum concentration at the outflow site was 0.6 mg/L.

Of the minor elements investigated, iron and manganese were detected in the greatest concentrations. The maximum concentration of iron detected in

samples from inflow sites was 24,000 µg/L at Morgan Creek (site 4). The maximum iron concentration in samples collected at the outflow site (site 5) was 4,100 µg/L. The maximum observed concentration of manganese in samples collected at inflow sites was 1,100 µg/L at New Hope Creek, Northeast Creek, and Morgan Creek (sites 2, 3, and 4, respectively). The maximum manganese concentration in samples collected at the outflow site (site 5) was 1,900 µg/L.

Mean annual outflow loads of nitrogen and phosphorus were as much as 67 and 40 percent of inflow loads, respectively. Maximum inflow yields were observed at the Morgan Creek site (site 4) and averaged 5.8 ton/mi^2 for nitrogen and 1.4 ton/mi^2 for phosphorus. Yields of these constituents at the outflow site averaged 1.5 and 0.2 ton/mi^2, respectively.

REFERENCES

Fishman, M.J., and Friedman, L.C., 1985, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, Bk. 5, Chap. A1, 709 p.

Guy, H.P., and Norman, V.W., 1970, Field methods for measurement of fluvial sediment: U.S. Geological Survey Techniques of Water-Resources Investigations, Bk. 3, Chap. C2, 59 p.

Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural water, 3d ed.: U.S. Geological Survey Water-Supply Paper 2254, 263 p.

Langbein, W.B., and Iseri, K.T., 1960, General introduction and hydrologic definitions: U.S. Geological Survey Water-Supply Paper 1541-A, 29 p.

National Oceanic and Atmospheric Administration, 1984, Climatological Data, Annual Summary: North Carolina.

_____1986, Climatological Data, Annual Summary: North Carolina.

North Carolina Department of Natural Resources and Community Development, 1985, Toxic substances in surface waters of the B. Everett Jordan Lake watershed: Raleigh, Division of Environmental Management, 126 p.

North Carolina Office of State Budget and Management, 1985, North Carolina municipal population, 1984: Raleigh, Management and Information Services, November, 27 p.

SAS Institute, Inc., 1982, SAS user's guide: Statistics, 1982 edition: Cary, N.C., SAS Institute, Inc., 584 p.

_____1985, SAS user's guide: Basics, 1985 edition: Cary, N.C., SAS Institute, Inc., 1,290 p.

Simmons, C.E., and Heath, R.C., 1979, Water-quality characteristics of streams in forested and rural areas of North Carolina: U.S. Geological Survey Water-Resources Investigations 79-108, 49 p.

U.S. Environmental Protection Agency, 1986, Quality criteria for water: Washington, D.C., U.S. Government Printing Office.

U.S. Geological Survey, 1983-86, Water resources data for North Carolina: U.S. Geological Survey Water-Data Report, issued annually.

U.S. Soil Conservation Service, 1984, Interim report--Haw River erosion study: Raleigh, N.C., U.S. Soil Conservation Service.

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 1, HAW RIVER

LOCATION.--Latitude 35°45'48", longitude 79°08'02"; Chatham County, on right bank 300 ft upstream from Pokeberry Creek, 0.9 mi south-southeast of Bynum, North Carolina, and 1.1 mi downstream from U.S. Highway 15 and 501; Hydrologic Unit 03030002; USGS downstream order identification number 02096960.

DRAINAGE AREA.--1,275 mi^2.

PERIOD OF RECORD.--October 1982 to November 1985.

Physical properties and concentrations of major dissolved constituents						
Property/constituent	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Instantaneous discharge (ft^3/s)	00061	40	3,600	20,200	1.5	--
Instantaneous specific conductance (µS/cm)	00095	40	169	435	52	114
pH (pH units)	00400	40	6.9	7.7	5.5	.5
Color (Platinum-cobalt units)	00080	34	119	1,500	10	261
Dissolved oxygen (mg/L)	00300	38	10.4	14.4	6	2.1
Water temperature (°C)	00010	40	16.4	31	1	7.9
Hardness (mg/L)	00900	34	31	48	15	9.2
Calcium (mg/L)	00915	34	7.2	12	3.7	2.2
Magnesium (mg/L)	00925	34	3.1	4.7	1.5	.9
Sodium (mg/L)	00930	34	22	66	3	20.1
Potassium (mg/L)	00935	34	3.8	9.2	1.8	1.9
Sulfate (mg/L)	00945	34	24	62	7.3	17.6
Chloride (mg/L)	00940	34	14	38	3.4	10.7
Fluoride (mg/L)	00950	34	.2	.8	<.1	.2
Silica (mg/L)	00955	34	11	17	6.6	2.8
Dissolved solids, residue at 180° C (mg/L)	70300	34	125	276	40	67
MBAS (mg/L)	38260	13	.2	2	<.01	.5
Suspended sediment (mg/L)	80154	40	123	826	4	195

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 1, HAW RIVER--Continued

Property/constituent (mg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Major nutrients						
Nitrogen, nitrate, total	00620	32	0.99	2.9	0.26	0.64
Nitrogen, nitrite, total	00615	35	.05	.17	<.01	.04
Nitrogen, nitrite plus nitrate, total	00630	40	1.1	2.9	.30	.64
Nitrogen, nitrite plus nitrate, dissolved	00631	14	.97	2.2	.35	.58
Nitrogen, ammonia, total	00610	34	.21	.92	.02	.19
Nitrogen, ammonia, dissolved	00608	15	.24	.93	.05	.23
Nitrogen, organic, total	00605	34	1.1	3.1	.01	.72
Nitrogen, organic, dissolved	00607	11	.95	2.8	.19	.77
Nitrogen, ammonia plus organic, total	00625	40	1.4	4.7	.30	.90
Nitrogen, ammonia plus organic, dissolved	00623	11	1.2	3	.40	.84
Nitrogen, total	00600	40	2.5	5.8	.90	1.13
Nitrogen, dissolved	00602	11	2.1	3.8	.92	1.10
Phosphorus, total	00665	40	.48	1.5	.14	.36
Phosphorus, dissolved	00666	15	.36	1.2	.07	.37
Phosphorus, ortho, total	70507	35	.42	1.4	.09	.37
Phosphorus, ortho, dissolved	00671	14	.21	.56	.06	.14
Carbon, organic, total	00680	32	9.6	21	2.5	4.34

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 1, HAW RIVER--Continued

Property/constituent (µg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Minor elements						
Arsenic, total	01002	34	1.2	2.0	<1.0	0.39
Arsenic, dissolved	01000	20	1.1	2	1	.31
Cadmium, total	01027	34	1.4	11	<1	1.74
Cadmium, dissolved	01025	20	1	2	<1	.22
Chromium, total	01034	22	15	40	<10	8
Chromium, dissolved	01030	8	1.3	3	<1	.71
Cobalt, total	01037	8	6.6	18	2	5.3
Cobalt, dissolved	01035	8	2.8	7	1	2.2
Copper, total	01042	20	15	67	3	16.1
Copper, dissolved	01040	8	4.3	6	2	1.5
Iron, total	01045	19	3,190	21,000	350	5,147
Iron, dissolved	01046	8	285	380	150	89
Lead, total	01051	34	8.4	39	<1	8.2
Lead, dissolved	01049	19	2.9	8	1	1.8
Manganese, total	01055	21	189	700	20	206
Manganese, dissolved	01056	8	38	85	13	25.4
Mercury, total	71900	34	.16	1	<.1	.16
Mercury, dissolved	71890	18	.16	.4	<.1	.09
Selenium, total	01147	34	<1	<1	<1	0
Selenium, dissolved	01145	20	<1	<1	<1	0
Zinc, total	01092	20	36	90	10	23.5
Zinc, dissolved	01090	8	11	25	4	7.5

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 2, NEW HOPE CREEK

LOCATION.--Latitude 35°53'05", longitude 78°57'58"; Durham County, on right bank 15 ft downstream from bridge on Secondary Road 1107, 0.5 mi southwest of Blands, North Carolina and 2 mi downstream from Third Fork Creek; Hydrologic Unit 03030002; USGS downstream order identification number 02097314.

DRAINAGE AREA.--75.9 mi^2.

PERIOD OF RECORD.--December 1982 to November 1985.

Physical properties and concentrations of major dissolved constituents						
Property/constituent	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Instantaneous discharge (ft^3/s)	00061	62	280	3,420	7	--
Instantaneous specific conductance (µS/cm)	00095	42	210	490	43	130
pH (pH units)	00400	42	6.5	7.2	5.4	.38
Color (Platinum-cobalt units)	00080	35	111	1,000	6	184
Dissolved oxygen (mg/L)	00300	40	6	12	1	2.9
Water temperature (°C)	00010	41	15.5	25.5	2.5	6.7
Hardness (mg/L)	00900	35	36	57	12	12.2
Calcium (mg/L)	00915	35	9.3	15	3	3.3
Magnesium (mg/L)	00925	35	3.1	4.8	1.2	.97
Sodium (mg/L)	00930	35	22	58	3.2	16.7
Potassium (mg/L)	00935	35	4.3	8.8	1.2	2.6
Sulfate (mg/L)	00945	35	24	57	6	14
Chloride (mg/L)	00940	35	18	45	3.1	13
Fluoride (mg/L)	00950	35	.5	1.2	<.1	.36
Silica (mg/L)	00955	35	11	16	4.6	3.2
Dissolved solids, residue at 180° C (mg/L)	70300	35	141	291	44	73
MBAS (mg/L)	38260	9	.2	.8	<.01	.3
Suspended sediment (mg/L)	80154	62	100	540	8	108

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 2, NEW HOPE CREEK--Continued

Property/constituent (mg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Major nutrients						
Nitrogen, nitrate, total	00620	35	1.5	8.9	0.07	2.1
Nitrogen, nitrite, total	00615	38	.10	.38	<.01	.08
Nitrogen, nitrite plus nitrate, total	00630	42	1.7	9	.10	2.2
Nitrogen, nitrite plus nitrate, dissolved	00631	13	1.2	6.7	.24	1.7
Nitrogen, ammonia, total	00610	37	2.3	11	.05	
Nitrogen, ammonia, dissolved	00608	13	1.4	11	.08	3
Nitrogen, organic, total	00605	37	1.7	183.1		
Nitrogen, organic, dissolved	00607	10	1.3	3	.76	
Nitrogen, ammonia plus organic, total	00625	43	4.3	25	.60	
Nitrogen, ammonia plus organic, dissolved	00623	11	3.5	14	.60	4
Nitrogen, total	00600	42	5.7	27	.80	4.9
Nitrogen, dissolved	00602	10	3.2	8.9	1.1	2.5
Phosphorus, total	00665	43	1.4	4.8	.08	
Phosphorus, dissolved	00666	14	.77	3	<.01	1
Phosphorus, ortho, total	70507	38	1.3	4.8	.02	1.4
Phosphorus, ortho, dissolved	00671	14	.78	3.4	.03	1.1
Carbon, organic, total	00680	36	10	19	5.6	3.2

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 2, NEW HOPE CREEK--Continued

Minor elements						
Property/constituent (µg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Arsenic, total	01002	34	1.2	3	<1	0.50
Arsenic, dissolved	01000	10	1.1	2	<1	.32
Cadmium, total	01027	34	2.5	27	<1	4.9
Cadmium, dissolved	01025	10	1.1	2	<1	.32
Chromium, total	01034	34	13	30	<10	5.9
Chromium, dissolved	01030	10	1.9	10	<1	2.9
Cobalt, total	01037	9	5.8	14	1	3.9
Cobalt, dissolved	01035	9	3	7	1	1.9
Copper, total	01042	33	15	130	3	23
Copper, dissolved	01040	9	4.4	8	1	2.2
Iron, total	01045	30	3,180	8,600	380	2,624
Iron, dissolved	01046	10	210	310	88	72
Lead, total	01051	32	8.1	43	<1	8.5
Lead, dissolved	01049	9	2.6	5	1	1.2
Manganese, total	01055	31	285	1,100	10	237
Manganese, dissolved	01056	10	214	1,000	21	292
Mercury, total	71900	34	.2	.7	<.1	.14
Mercury, dissolved	71890	11	.2	.4	<.1	.13
Selenium, total	01147	33	<1	<1	<1	0
Selenium, dissolved	01145	9	<1	<1	<1	0
Zinc, total	01092	34	56	440	10	71
Zinc, dissolved	01090	10	19	59	6	14.8

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 3, NORTHEAST CREEK

LOCATION.--Latitude 35°52'20", longitude 78°54'49"; Durham County, on left bank at downstream side of bridge on Secondary Road 1100, 1.3 mi west of Genlee, North Carolina, and 1.6 mi downstream from Burden Creek; Hydrologic Unit 03030002; USGS downstream order identification number 0209741955.

DRAINAGE AREA.--21.1 mi^2.

PERIOD OF RECORD.--October 1982 to November 1985.

Physical properties and concentrations of major dissolved constituents						
Property/constituent	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Instantaneous discharge (ft^3/s)	00061	67	122	925	1.5	--
Instantaneous specific conductance (µS/cm)	00095	42	321	810	42	223
pH (pH units)	00400	42	6.6	7.1	5.5	.31
Color (Platinum-cobalt units)	00080	36	158	1,500	3	270
Dissolved oxygen (mg/L)	00300	40	7.7	12.7	3.9	2.1
Water temperature (°C)	00010	42	15.6	26.5	2	6.5
Hardness (mg/L)	00900	36	61	160	12	34
Calcium (mg/L)	00915	36	18	52	2.9	11.4
Magnesium (mg/L)	00925	36	4	7.6	1.1	1.5
Sodium (mg/L)	00930	36	34	100	3.6	26
Potassium (mg/L)	00935	36	5.1	18	1.2	3.8
Sulfate (mg/L)	00945	36	43	170	8	40
Chloride (mg/L)	00940	36	30	95	3.1	24
Fluoride (mg/L)	00950	36	.7	2.1	<.1	.60
Silica (mg/L)	00955	36	9.6	14	47	2.8
Dissolved solids, residue at 180° C (mg/L)	70300	36	213	508	43	141
MBAS (mg/L)	38260	8	.1	.2	<.01	.07
Suspended sediment (mg/L)	80154	67	121	1,110	6	194

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 3, NORTHEAST CREEK--Continued

Property/constituent (mg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Major nutrients						
Nitrogen, nitrate, total	00620	37	6.1	22	0.21	6.5
Nitrogen, nitrite, total	00615	37	.1	1.1	.01	.18
Nitrogen, nitrite plus nitrate, total	00630	42	6.3	22	.30	6.4
Nitrogen, nitrite plus nitrate, dissolved	00631	13	5.3	21	.15	7
Nitrogen, ammonia, total	00610	36	.3	5.4	<.01	.89
Nitrogen, ammonia, dissolved	00608	13	.1	.2	<.01	.06
Nitrogen, organic, total	00605	34	1.5	15	.22	2.5
Nitrogen, organic, dissolved	00607	8	1.1	1.9	.59	.54
Nitrogen, ammonia plus organic, total	00625	42	1.9	20	.30	3
Nitrogen, ammonia plus organic, dissolved	00623	9	1.2	2.1	.70	.56
Nitrogen, total	00600	42	8.2	27	1.2	7.3
Nitrogen, dissolved	00602	9	6.1	22	.85	7.5
Phosphorus, total	00665	42	2.5	13	.12	2.8
Phosphorus, dissolved	00666	14	1.5	4.4	.03	1.9
Phosphorus, ortho, total	70507	37	2.1	6.2	.09	2.1
Phosphorus, ortho, dissolved	00671	13	1.5	4.5	.05	1.9
Carbon, organic, total	00680	34	9.7	17	5.8	3.4

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 3, NORTHEAST CREEK--Continued

Property/constituent (µg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Minor elements						
Arsenic, total	01002	35	1.5	4	<1	0.70
Arsenic, dissolved	01000	8	1.3	2	1	.46
Cadmium, total	01027	34	1.3	6	<1	--
Cadmium, dissolved	01025	8	<1	<1	<1	0
Chromium, total	01034	36	14	40	<10	7.7
Chromium, dissolved	01030	8	1.1	2	<1	.35
Cobalt, total	01037	8	5.6	14	2	4
Cobalt, dissolved	01035	8	2.4	5	1	1.6
Copper, total	01042	35	23	99	6	16.2
Copper, dissolved	01040	8	12	21	6	6
Iron, total	01045	32	4,180	21,000	280	5,340
Iron, dissolved	01046	8	146	380	33	116
Lead, total	01051	35	8.7	34	<1	9.1
Lead, dissolved	01049	8	2.4	5	<1	1.5
Manganese, total	01055	32	214	1,100	50	226
Manganese, dissolved	01056	8	53	82	17	20
Mercury, total	71900	36	.2	.7	<.1	.15
Mercury, dissolved	71890	6	.2	.3	<.1	.11
Selenium, total	01147	35	<1	<1	<1	0
Selenium, dissolved	01145	8	<1	<1	<1	0
Zinc, total	01092	36	78	480	10	76
Zinc, dissolved	01090	7	34	80	11	25

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 4, MORGAN CREEK

LOCATION.--Latitude 35°53'36", longitude 79°01'10"; Orange County, on left bank 3.8 mi downstream from U.S. Highway 501, and 2.5 mi southeast of Chapel Hill, North Carolina; Hydrologic Unit 03030002; USGS downstream order identification number 02097517.

DRAINAGE AREA.--41.0 mi^2.

PERIOD OF RECORD.--November 1982 to November 1985.

Physical properties and concentrations of major dissolved constituents						
Property/constituent	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Instantaneous discharge (ft^3/s)	00061	65	223	1,400	5.6	--
Instantaneous specific conductance (µS/cm)	00095	41	249	565	50	153
pH (pH units)	00400	41	6.7	7.4	6	.32
Color (Platinum-cobalt units)	00080	35	48	320	5	69
Dissolved oxygen (mg/L)	00300	37	9	12.7	6.2	1.7
Water temperature (°C)	00010	39	18.2	28	6	6.6
Hardness (mg/L)	00900	35	34	54	15	11.4
Calcium (mg/L)	00915	35	9	15	3.5	3.3
Magnesium (mg/L)	00925	35	2.9	4.1	1.3	.81
Sodium (mg/L)	00930	35	33	94	3.8	24
Potassium (mg/L)	00935	35	5.2	11	1.4	3.1
Sulfate (mg/L)	00945	34	25	49	6	13.8
Chloride (mg/L)	00940	33	19	39	3.5	12.4
Fluoride (mg/L)	00950	35	.6	1.4	<.1	.42
Silica (mg/L)	00955	35	14	19	6.2	3.1
Dissolved solids, residue at 180° C (mg/L)	70300	35	173	347	54	91
MBAS (mg/L)	38260	10	.1	.2	<.01	.06
Suspended sediment (mg/L)	80154	65	149	2,360	3	378

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 4, MORGAN CREEK--Continued

Major nutrients						
Property/constituent (mg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Nitrogen, nitrate, total	00620	29	6.9	18	0.26	6.68
Nitrogen, nitrite, total	00615	36	.04	.23	<.01	.04
Nitrogen, nitrite plus nitrate, total	00630	41	6.9	18	.30	6.28
Nitrogen, nitrite plus nitrate, dissolved	00631	11	5.6	16	.29	6.79
Nitrogen, ammonia, total	00610	36	.18	.89	<.01	.17
Nitrogen, ammonia, dissolved	00608	11	.20	.89	.04	.25
Nitrogen, organic, total	00605	34	1	2.7	.26	.51
Nitrogen, organic, dissolved	00607	9	.86	1.6	.19	.53
Nitrogen, ammonia plus organic, total	00625	40	1.3	6.6	.30	1
Nitrogen, ammonia plus organic, dissolved	00623	10	1.1	1.7	.30	.44
Nitrogen, total	00600	40	8	20	.80	6.40
Nitrogen, dissolved	00602	9	7.1	17	.75	7.58
Phosphorus, total	00665	40	2.2	6.4	.12	1.92
Phosphorus, dissolved	00666	12	1.5	4.9	.04	1.91
Phosphorus, ortho, total	70507	35	2.1	6.2	.03	1.96
Phosphorus, ortho, dissolved	00671	11	1.3	5.1	.03	1.87
Carbon, organic, total	00680	34	7.3	18	2.5	2.84

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 4, MORGAN CREEK--Continued

Minor elements						
Property/constituent (µg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Arsenic, total	01002	33	1.2	3	<1	0.44
Arsenic, dissolved	01000	6	1	1	1	0
Cadmium, total	01027	33	1.2	5	<1	--
Cadmium, dissolved	01025	6	1	1	<1	0
Chromium, total	01034	34	13	30	<10	5.24
Chromium, dissolved	01030	6	1.3	3	<1	.82
Cobalt, total	01037	6	4.8	11	1	3.66
Cobalt, dissolved	01035	6	2.2	7	<1	2.40
Copper, total	01042	33	12	72	4	12
Copper, dissolved	01040	6	5.7	12	3	3.67
Iron, total	01045	31	2,580	24,000	200	5,150
Iron, dissolved	01046	6	160	330	63	97
Lead, total	01051	33	7.9	43	<1	8.99
Lead, dissolved	01049	6	3.3	4	2	.82
Manganese, total	01055	31	172	1,100	40	200
Manganese, dissolved	01056	6	42	59	25	12.9
Mercury, total	71900	34	.16	.4	<.1	.09
Mercury, dissolved	71890	5	.18	.3	<.1	.08
Selenium, total	01147	33	1	<1	<1	0
Selenium, dissolved	01145	6	1	<1	<1	0
Zinc, total	01092	34	57	350	20	59.8
Zinc, dissolved	01090	6	18	33	6	13.3

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 5, HAW RIVER BELOW JORDAN LAKE DAM

LOCATION.--Latitude 35°39'11", longitude 79°04'03"; Chatham County, on right bank 300 ft downstream from B. Everett Jordan Dam, 2.5 mi north of Moncure, North Carolina, and 4.2 mi upstream from mouth; Hydrologic Unit 03030002; USGS downstream order identification number 02098198.

DRAINAGE AREA.--1,689 mi^2.

PERIOD OF RECORD.--October 1982 to November 1985.

Physical properties and concentrations of major dissolved constituents						
Property/constituent	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Instantaneous discharge (ft^3/s)	00061	40	2,610	12,800	56	--
Instantaneous specific conductance (µS/cm)	00095	38	129	250	70	43
pH (pH units)	00400	38	6.6	8.5	5.4	.51
Color (Platinum-cobalt units)	00080	32	59	150	7	41
Dissolved oxygen (mg/L)	00300	38	9.6	14.9	4.9	2.6
Water temperature (°C)	00010	38	16.7	26.5	4	7.2
Hardness (mg/L)	00900	32	28	35	18	4.7
Calcium (mg/L)	00915	32	6.7	8.5	4.4	1.1
Magnesium (mg/L)	00925	32	2.7	3.8	1.8	.47
Sodium (mg/L)	00930	32	13	40	5.1	7.8
Potassium (mg/L)	00935	32	2.8	5	1.8	.78
Sulfate (mg/L)	00945	32	16	31	8.6	5.6
Chloride (mg/L)	00940	32	9.6	21	4.6	3.9
Fluoride (mg/L)	00950	32	.2	.4	<.1	.07
Silica (mg/L)	00955	32	8.9	13	5.6	1.9
Dissolved solids, residue at 180° C (mg/L)	70300	31	92	141	63	22
MBAS (mg/L)	38260	9	.1	.14	<.01	.04
Suspended sediment (mg/L)	80154	36	41	130	3	28

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 5, HAW RIVER BELOW JORDAN LAKE DAM--Continued

Major nutrients						
Property/constituent (mg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Nitrogen, nitrate, total	00620	32	0.5	0.96	0.10	0.25
Nitrogen, nitrite, total	00615	33	.04	.15	<.01	.03
Nitrogen, nitrite plus nitrate, total	00630	38	.5	1.2	.20	.26
Nitrogen, nitrite plus nitrate, dissolved	00631	11	.5	.82	.14	.23
Nitrogen, ammonia, total	00610	33	.3	1.1	<.01	.22
Nitrogen, ammonia, dissolved	00608	10	.2	.26	.11	.05
Nitrogen, organic, total	00605	32	.7	2.2	.08	.39
Nitrogen, organic, dissolved	00607	8	.5	.67	.36	.10
Nitrogen, ammonia plus organic, total	00625	38	1	2.5	.30	.49
Nitrogen, ammonia plus organic, dissolved	00623	8	.7	.90	.50	.12
Nitrogen, total	00600	38	1.6	3.2	.70	.53
Nitrogen, dissolved	00602	6	1.2	1.6	1	.24
Phosphorus, total	00665	36	.2	.6	.05	.10
Phosphorus, dissolved	00666	11	.1	.2	.01	.06
Phosphorus, ortho, total	70507	32	.1	.2	<.01	.06
Phosphorus, ortho, dissolved	00671	11	.1	.2	.03	.05
Carbon, organic, total	00680	26	7.1	10	5.2	1.4

Table 8.--*Statistical summary of physical properties and concentrations of major dissolved constituents, major nutrients, and minor elements in water from the study sites, 1982-85*--Continued

[ft, foot; mi, mile; mi^2, square mile; ft^3/s, cubic feet per second; --, not determined; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; <, less than (Detection limits are minimum values shown with this symbol; where minimum values are the detection limits, means are calculated as if minimum values are equal to detection limits.); MBAS, methylene blue active substances; µg/L, micrograms per liter]

SITE 5, HAW RIVER BELOW JORDAN LAKE DAM--Continued

Minor elements						
Property/constituent (µg/L)	Parameter code	Number of samples	Mean	Maximum	Minimum	Standard deviation
Arsenic, total	01002	31	1.2	4	<1	0.60
Arsenic, dissolved	01000	18	1.1	3	<1	.47
Cadmium, total	01027	30	1.6	11	<1	1.9
Cadmium, dissolved	01025	18	1.1	3	<1	.47
Chromium, total	01034	17	11	20	<10	2.4
Chromium, dissolved	01030	4	1.3	2	<1	.50
Cobalt, total	01037	4	4	8	2	2.8
Cobalt, dissolved	01035	4	2	4	1	1.4
Copper, total	01042	15	4.6	9	3	1.6
Copper, dissolved	01040	4	3.3	4	2	.96
Iron, total	01045	15	1,520	4,100	230	1,010
Iron, dissolved	01046	4	539	1,800	58	845
Lead, total	01051	30	5.2	11	<1	3.2
Lead, dissolved	01049	17	2.8	8	<1	2.2
Manganese, total	01055	15	379	1,900	30	529
Manganese, dissolved	01056	4	569	1,900	55	890
Mercury, total	71900	30	.2	1.4	<.1	.24
Mercury, dissolved	71890	14	.1	.3	<.1	.06
Selenium, total	01147	31	<1	<1	<1	0
Selenium, dissolved	01145	18	<1	<1	<1	0
Zinc, total	01092	16	24	100	<10	23
Zinc, dissolved	01090	3	7.3	13	<3	5.1

GLOSSARY

Some of the technical terms used in this report are defined here for the convenience of the reader. See Langbein and Iseri (1960) for additional information and associated hydrologic terminology. Statistical terms are defined with respect to the estimation of nutrient loads and data tables presented in this report.

Anion is an ion having a negative charge.

Cation is an ion having a positive charge.

Correlation coefficient is a term relating the standard error of estimate and the standard deviation of the values of the dependent variable. It is expressed as:

$$r = \frac{bs_x}{s_y}$$

where: r is the correlation coefficient,
b is the slope of the regression line,
s_x is the standard deviation of the independent variable, and
s_y is the standard deviation of the dependent variable.

Cubic foot per second (ft^3/s) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second, 448.8 gallons per minute, or 0.02832 cubic meters per second.

Discharge is the volume of water (or more broadly, volume of fluid plus suspended sediment) that passes a given point within a given period of time.

Dissolved is that material in a representative water sample which passes through a 0.45 micron membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

Drainage area of a stream at a specific location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontribution areas, within the area unless otherwise noted.

Drainage basin is a part of the surface of the Earth that is occupied by a drainage system which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Hydrologic unit is a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as delineated by the Office of Water Data Coordination on the State Hydrologic Unit Maps; each hydrologic unit is identified by an 8-digit number.

Maximum is the largest value in a group of observations.

Mean is the sum of the numerical values of individual observations divided by the total number of observations in the group.

Mean discharge is the arithmetic mean of individual daily mean discharges during a specific period.

Instantaneous discharge is the discharge at a particular instant of time.

Microgram per liter (µg/L) is a unit expressing the concentration of chemical constituents in solution as the weight (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Minimum is the smallest value in a group of observations.

Parameter code is a 5-digit number used in the U.S. Geological Survey computerized data system, WATSTORE, to uniquely identify a specific

constituent. The codes used in WATSTORE are the same as those used in the U.S. Environmental Protection Agency data system, STORET. The Environmental Protection Agency assigns and approves all requests for new codes.

r^2 is the square of the correlation coefficient "r," often called the coefficient of determination. A perfect relationship has a value of ± 1, and a completely random relation has a value of zero.

Regression equation is an equation defining the relation between a dependent and an independent variable. For a logarithmic relation, the equation is:

$$y = ax^b$$

where: log x and log y are values of the independent and dependent variables, respectively,
coefficient b is the slope of the line, and
constant a is the y-axis intercept.

Standard deviation is the square root of the sum of the squares of deviations from the mean of all observations in a group divided by the number of observations minus one. It is expressed mathematically as:

$$S = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{N-1}}$$

where: S is the standard deviation,
x_i is the i'th value of x,
$\bar{x}$ is the mean value of x, and
N is the total number of observations.

Tons per day is the quantity of substance in solution or suspension that passes a stream section during a 24-hour day.

Total is the whole amount of a given constituent in a representative water suspended-sediment sample, regardless of the constituent's physical or chemical form. This term is used only when the analytical procedure assures

measurement of at least 95 percent of the constituent present in both the dissolved and suspended phases of the sample. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total." (Note that the word "total" does double duty here, indicating both that the sample consists of a water suspended-sediment mixture and that the analytical method determines all of the constituent in the sample.)

Total load (tons) is the whole quantity of any individual constituent, as measured mass or volume, that is dissolved in a specific amount of water during a given time. It is computed by multiplying the total discharge (in ft^3/s) times the concentration (in mg/L) of the constituent times the factor 0.0027 times the number of days.

Water year of the U.S. Geological Survey is the 12-month period October 1 through September 30. The water year is determined by the calendar year in which it ends and includes 9 of the 12 months. Thus, the year ended September 30, 1986, is called the "1986 water year."

Yield is the quantity of substance in solution or suspension per unit area of drainage basin, commonly measured in tons per square mile per time unit.

WATER-QUALITY CHARACTERISTICS OF INFLOW TO AND OUTFLOW FROM B. EVERETT JORDAN LAKE, NORTH CAROLINA, 1982-86

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